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IS 11000-2-2 (2008): Fire hazard testing, Part 2: Test methods, Section 2: Needle-flame test Method - Apparatus, Cofirmatory test arrangement and guidance [LITD 1: Environmental Testing Procedure]



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भाग 2 परीक्षण विधियाँ

अनुभाग 2 सुई ज्वाला परीक्षण विधि — उपकरण, पुष्टि परीक्षण व्यवस्था एवं मार्गदर्शिका
(पहला पुनरीक्षण)

Indian Standard
FIRE HAZARD TESTING

PART 2 TEST METHODS

**Section 2 Needle-Flame Test Method — Apparatus, Confirmatory Test
Arrangement and Guidance**

(First Revision)

ICS 13.220.40; 29.020

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NATIONAL FOREWORD

This Indian Standard (Part 2/Sec 2) (First Revision) which is identical with IEC 60695-11-5 : 2004 'Fire hazard testing — Part 11-5: Test flames — Needle-flame test method — Apparatus confirmatory test arrangement and guidance' issued by the International Electrotechnical Commission (IEC) was adopted by the Bureau of Indian Standards on the recommendation of the Environmental Testing Procedures Sectional Committee and approval of the Electronics and Information Technology Division Council.

This standard was first published in 1984. This revision has been undertaken to align it with latest IEC publication of IEC 60695-11-5 : 2004.

The text of IEC Standard has been approved as suitable for publication as an Indian Standard without deviations. Certain conventions are, however, not identical to those used in Indian Standards. Attention is particularly drawn to the following:

- Wherever the words 'International Standard' appear referring to this standard, they should be read as 'Indian Standard'.
- Comma (,) has been used as a decimal marker, while in Indian Standards, the current practice is to use a point (.) as the decimal marker.

In this adopted standard, reference appears to the following International Standard for which Indian Standard also exists. The corresponding Indian Standard, which is to be substituted in its respective place, is listed below along with its degree of equivalence for the edition indicated:

<i>International Standard</i>	<i>Corresponding Indian Standard</i>	<i>Degree of Equivalence</i>
ISO/IEC Guide 51 : 1999 ¹⁾ Safety aspects — Guidelines for their inclusion in standards	IS/ISO/IEC Guide 51 : 2005 Safety aspects — Guidelines for their inclusion in standards	Technically Equivalent

The technical committee responsible for the preparation of this standard has reviewed the provisions of the following International Standards referred in this standard and has decided that they are acceptable for use in conjunction with this standard:

<i>International Standard</i>	<i>Title</i>
IEC Guide 104 : 1997	The preparation of safety publications and the use of basic safety publications and group safety publications
ISO/IEC 13943 : 2000	Fire safety — Vocabulary
ISO 4046-4 : 2002	Paper, board, pulps and related terms — Vocabulary — Part 4: Paper and board grades and converted products
ASTM-B187 : 2000	Standard specification for copper, bus bar, rod, and shapes and general purpose rod, bar, and shapes

Only the English language text of the International Standard has been retained while adopting it as an Indian Standard, and as such the page numbers given here are not the same as in the IEC Publication.

For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS 2 : 1960 'Rules for rounding off numerical values (revised)'. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

¹⁾ Since revised in 2005.

Indian Standard

FIRE HAZARD TESTING

PART 2 TEST METHODS

Section 2 Needle-Flame Test Method — Apparatus, Confirmatory Test Arrangement and Guidance

(First Revision)

1 Scope

This part of IEC 60695 specifies a needle-flame test to simulate the effect of a small flame which may result from fault conditions, in order to assess by a simulation technique the fire hazard.

It is applicable to electrotechnical equipment, its sub-assemblies and components and to solid electrical insulating materials or other combustible materials.

One of the responsibilities of a technical committee is, wherever applicable, to make use of basic safety publications in the preparation of its publications.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC Guide 104:1997, *The preparation of safety publications and the use of basic safety publications and group safety publications*

ISO/IEC Guide 51:1999, *Safety aspects – Guidelines for their inclusion in standards*

ISO/IEC 13943:2000, *Fire safety – Vocabulary*

ISO 4046-4:2002, *Paper, board, pulps and related terms – Vocabulary – Part 4: Paper and board grades and converted products*

ASTM-B187, *Standard specification for copper, bus bar, rod, and shapes and general purpose rod, bar, and shapes*

3 Terms and definitions

For the purposes of this document, the terms and definitions of ISO/IEC 13943 apply.

4 General description of the test

Warning

Precautions shall be taken to safeguard the health of the personnel conducting tests against:

- the risks of explosion or fire;
- the inhalation of smoke and/or toxic products;
- toxic residues.

The test is performed to determine that, under defined conditions, the test flame does not cause ignition of parts, or that a combustible part ignited by the test flame has a limited duration of burning or a limited extent of burning, without spreading fire by flames or burning or glowing particles falling from the test specimen.

This test determines the effects on the test specimen of a small flame such as may arise from other ignited components and the relevant product specification shall specify the duration of flame application and the criteria for acceptance.

5 Description of the test apparatus

5.1 Burner

The burner to produce the test flame shall consist of a tube at least 35 mm long with a bore of $0,5 \text{ mm} \pm 0,1 \text{ mm}$ and an outer diameter not exceeding 0,9 mm.

NOTE The tubing specified in ISO 9626 [1]² (0,8 mm normal walled or thin walled) meets the requirements in this standard for an internal diameter of $0,5 \text{ mm} \pm 0,1 \text{ mm}$ and an outside diameter no greater than 0,9 mm.

The burner is supplied with butane or propane gas having a purity of at least 95 %. There shall be no air admitted to the burner tube.

5.2 Flame

With the axis of the burner in the vertical position, the gas supply is adjusted so that the length of the flame is $12 \text{ mm} \pm 1 \text{ mm}$, when viewed in subdued light against a dark background (see Figure 1a). The flame shall be confirmed using the apparatus and procedure detailed in Annex A. The test time for the temperature to increase from $100 \text{ }^{\circ}\text{C} \pm 5 \text{ }^{\circ}\text{C}$ to $700 \text{ }^{\circ}\text{C} \pm 3 \text{ }^{\circ}\text{C}$ shall be $23,5 \text{ s} \pm 1,0 \text{ s}$.

5.3 Laboratory fumehood/chamber

The laboratory fumehood/chamber shall have an inside volume of at least $0,5 \text{ m}^3$. The chamber shall provide a draught-free environment, whilst allowing normal thermal circulation of air past the test specimen. The chamber shall permit observation of the test in progress. The inside surfaces of the walls shall be of a dark colour.

² Figures in square brackets refer to the bibliography. 2

For safety and convenience, it is desirable that this enclosure (which can be completely closed) be fitted with an extraction device, such as an exhaust fan, to remove products of combustion, which may be toxic. The extraction device shall be turned off during the test and turned on immediately after the timing measurements have been made. A positive closing damper may be needed.

NOTE Placing a mirror in the chamber, to provide a rear view of the test specimen, has been found to be useful

5.4 Specified layer

To evaluate the possibility of spread of fire, for example by burning or glowing particles falling from the test specimen, a layer of the material or components normally surrounding or situated underneath the test specimen is placed underneath the test specimen at a distance equal to the distance between the test specimen and the surrounding material or components when the test specimen is mounted as in normal use.

If the test specimen is a sub-assembly or a component of the equipment and is tested separately, a piece of flat smooth wooden board, approximately 10 mm thick covered in close contact with a single layer of wrapping tissue, is positioned at a distance of $200 \text{ mm} \pm 5 \text{ mm}$ below the place where the needle-flame is applied to the test specimen, unless otherwise specified in the relevant specification. Wrapping tissue as specified in 4.215 of ISO 4046-4 is a soft and strong, lightweight wrapping tissue 12 g/m^2 to 30 g/m^2 .

If the test specimen is a complete free-standing equipment, it is placed in its normal position of use on the tissue covered wooden board, extending for a minimum of 100 mm outside the base of the equipment in all directions.

If the test specimen is a complete wall-mounted equipment, it is fixed in its normal position of use $200 \text{ mm} \pm 5 \text{ mm}$ above the tissue covered wooden board.

Means to fix the test specimen and the burner in position may be necessary.

5.5 Timing device

The timing device shall have a tolerance of not more than 0,5 s.

6 Test specimen

If possible, the test specimen shall be a complete equipment, sub-assembly or component. If it is necessary to take away parts of an enclosure or to cut off a suitable part to perform the test, care shall be taken to ensure that the test conditions are not significantly different from those occurring in normal use with regard to shape, ventilation conditions, effect of thermal stresses and possible flames occurring, or burning or glowing particles falling in the vicinity of the test specimen.

If the test specimen is a suitable part cut from a larger unit, care shall be taken to ensure that in this particular case the test flame is not applied incorrectly, for example to an edge created by cutting.

If it is not possible to conduct the test on a sub-assembly or component within the equipment, the test is conducted on a test specimen removed from the equipment.

7 Severities

Preferred values of duration of application (t_a) of test flame are as follows:

- 5 s, 10 s, 20 s, 30 s, 60 s, 120 s.

The tolerance for all values is ${}^0_{-1}$ s.

NOTE The duration of application of the test flame should be chosen in relation to the characteristics of the end product.

8 Conditioning

If not otherwise specified in the relevant specification, the test specimen, the wooden board and the tissue paper shall be conditioned for not less than 24 h in an atmosphere having a temperature between 15 °C and 35 °C and a relative humidity between 45 % and 75 % before starting the test.

9 Test procedure

9.1 Position of test specimen

Unless otherwise specified in the relevant specification, the test specimen is arranged in a position of normal use such that ignition is most likely to occur during the test. The means to fix the test specimen shall not influence the effect of the test flame or the propagation of flames in a way other than that occurring under normal conditions of use.

9.2 Application of needle-flame

The test flame is applied to that part of the surface of the test specimen which is most likely to be affected by flames resulting from normal use or from fault conditions. Examples of flame test positions are shown in Figures 1b and 1c.

The duration of application of the test flame shall be as specified in the relevant specification.

The test flame is positioned so that the tip of the flame is in contact with the surface of the test specimen. The test flame is removed after the specified time.

If the test specimen drips molten or flaming material during the application of the flame, the burner may be tilted up to 45 ° from the vertical to prevent material from dripping into the burner tube while maintaining an 8 mm ± 1 mm spacing between the centre of the top of the burner and the remaining portion of the test specimen, ignoring any strings of molten material.

When required by the relevant specification, the test is applied at more than one point on the same test specimen, in which case care shall be taken to ensure that any deterioration caused by previous tests will not affect the result of the test to be conducted.

9.3 Number of test specimens

Unless otherwise specified in the relevant specification, the test is performed on three test specimens.

10 Observations and measurements

In the case of ignition of the test specimen and/or the specified layer and/or the surrounding parts, the duration of burning (t_b) is measured and reported.

Duration of burning denotes the time interval from the moment the test flame is removed from the test specimen, until the last flames have extinguished and the glowing of the test specimen, the specified layer and/or the surrounding parts is no longer visible.

11 Evaluation of test results

Unless otherwise prescribed in the relevant specification, the test specimen is considered to have satisfactorily withstood the needle-flame test if one of the following situations applies:

- a) There is no flame and no glowing of the test specimen and no ignition of the specified layer or wrapping tissue.
- b) Flames or glowing of the test specimen and the surrounding parts extinguish within 30 s after the removal of the needle-flame, that is $t_b < 30$ s. Also, the surrounding parts have not burnt away completely and there has been no ignition of the specified layer or wrapping tissue.

12 Information to be given in the relevant specification

The relevant specification shall indicate the following details:

- a) any conditioning, if different from that specified in Clause 8;
- b) number of test specimens, if different from that specified in 9.3;
- c) position of the test specimen (see 9.1);
- d) surface to be tested and the point of application (see 9.2);
- e) the specified layer to be used to evaluate the effect of burning or glowing particles falling from the test specimen (see 5.4);
- f) level of severity:
 - the duration of application of the test flame (t_a) (see Clause 7) ;
- g) requirements if different from Clauses 10 and 11:
 - the permissible duration and extent of burning, considering the design and arrangements of the various parts, shields and barriers inside the equipment;
 - whether the criteria specified are sufficient to check compliance with the safety requirements, or whether further criteria should be introduced.

13 Test report

The test report shall include the following information:

- a) the type and description of the test specimen (see Clause 6);
- b) the method of preparation (see Clause 6);
- c) any conditioning of the test specimens (see Clause 8);
- d) the number of test specimens (see 9.3);
- e) level of severity:
 - the duration of application of the test flame (t_a) (see Clauses 7 and 12) ;
- f) the surface tested and the point of application of the needle-flame (see 9.2);
- g) the specified layer used to evaluate the effect of burning or glowing particles falling from the test specimen (see 5.4);
- h) whether the test flame has been applied at more than one point on the same test specimen, (see 9.2); and
- i) test results (see Clauses 10 and 11).

Dimensions in millimetres

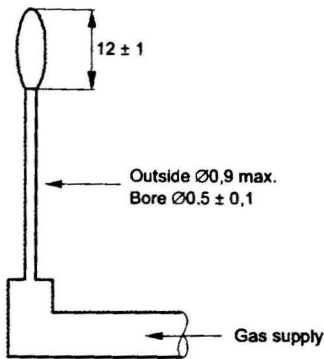


Figure 1a – Flame adjustment

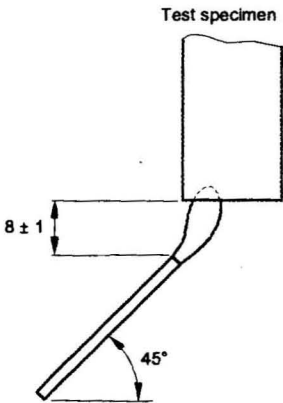


Figure 1b – Test position (example)

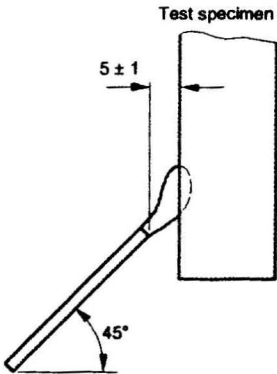


Figure 1c – Test position (example)

Figure 1 – Needle burner

Annex A
(normative)

Confirmatory test arrangement

A.1 Confirmation of the test flame – Principle

The time for the temperature of the copper block, described in Figure A.1 to increase from $100\text{ }^{\circ}\text{C} \pm 5\text{ }^{\circ}\text{C}$ to $700\text{ }^{\circ}\text{C} \pm 3\text{ }^{\circ}\text{C}$ shall be $23,5\text{ s} \pm 1,0\text{ s}$, when the flame confirmatory test arrangement of Figure A.2 is used.

NOTE Detailed background information for the confirmation of a test flame can be found in IEC 60695-11-40 [2].

A.2 Test apparatus

A.2.1 Burner

The burner shall be in accordance with 5.1.

A.2.2 Control valve

One control valve is required to set the gas flow rate.

A.2.3 Copper block

The copper block material shall be specified as: Cu-ETP UNS C11000 (see ASTM-B187). The diameter of the copper block shall be $4\text{ mm} \pm 0,01\text{ mm}$ with a mass of $0,58\text{ g} \pm 0,01\text{ g}$ in the fully machined and polished but undrilled state, see Figure A.1.

A.2.4 Thermocouple

A sheathed fine wire type K (NiCr/NiAl) with an outer sheath diameter of 0,5 mm.

The preferred method of fastening the thermocouple to the copper block is by compressing the copper around the thermocouple, after first ensuring that the thermocouple is inserted to the full depth of the hole as shown in Figure A.2.

A.2.5 Temperature indicating, recording and timing devices

These devices shall be appropriate for the measurement of the time for the copper block to heat up from $100\text{ }^{\circ}\text{C} \pm 5\text{ }^{\circ}\text{C}$ to $700\text{ }^{\circ}\text{C} \pm 3\text{ }^{\circ}\text{C}$ with a time uncertainty of 0,1 s. The timing device shall have a tolerance of not more than 0,5 s.

A.3 Procedure

An example of a suitable gauge for the adjustment of flame height is given in Figure A.3. The fixture shall be constructed such that it does not rest on the flame end of the burner tube nor disturb the root of the burner flame.

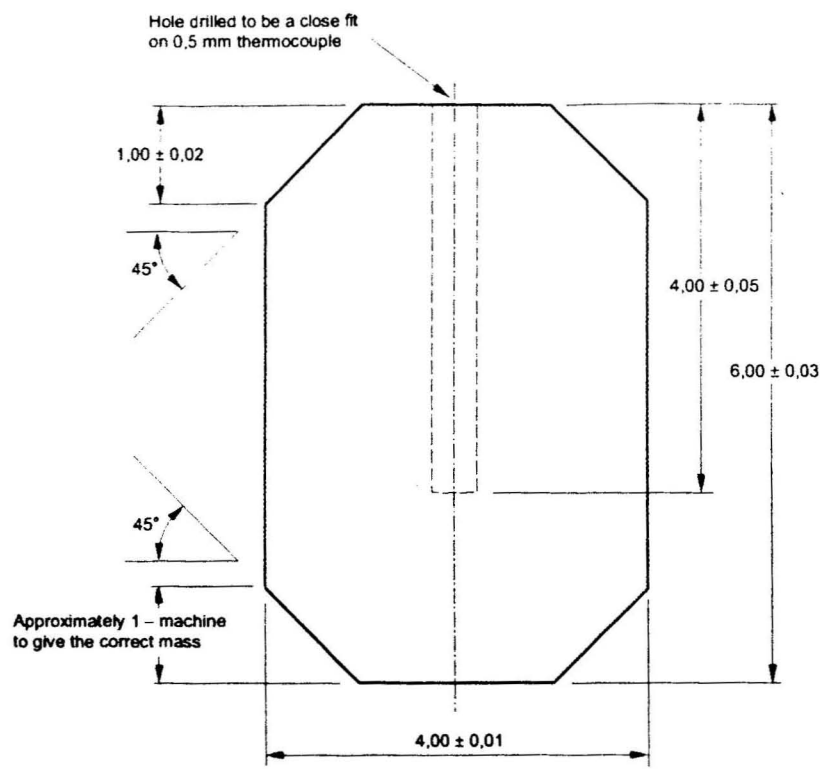
- Set up the confirmatory test arrangement according to Figure A.2 in a draught-free environment, ensuring leak-free gas connections.
- Temporarily remove the burner away from the copper block to ensure no influence of the flame on the copper block during the preliminary adjustment of the gas flow rate.
- Ignite the gas and adjust the gas flow rate to give a flame height of $12 \text{ mm} \pm 1 \text{ mm}$ when viewed in subdued light against a dark background.

NOTE 1 In case of dispute, a light level of 20 lux should be used.

- Wait for a period of at least 5 min to allow the burner conditions to reach equilibrium and then readjust the flame height, if necessary.
- With the temperature/time indicating/recording devices operational, re-position the burner under the copper block.
- Conduct three determinations of the time for the temperature of the copper block to increase from $100 \text{ }^{\circ}\text{C} \pm 5 \text{ }^{\circ}\text{C}$ to $700 \text{ }^{\circ}\text{C} \pm 3 \text{ }^{\circ}\text{C}$. Allow the copper block to cool naturally in air to below $50 \text{ }^{\circ}\text{C}$ between determinations.

NOTE 2 At temperatures above $700 \text{ }^{\circ}\text{C}$, the thermocouple can be easily damaged, therefore it is advisable to remove the burner immediately after reaching $700 \text{ }^{\circ}\text{C}$.

- If the copper block has not been used before, conduct a preliminary run to condition the copper block surface. Discard the result.
- Calculate the mean time in seconds as the result.
- The flame is confirmed if the result is within the range $23,5 \text{ s} \pm 1,0 \text{ s}$.
- The flame shall be confirmed in accordance with this Annex A every time the gas supply is changed or replaced.

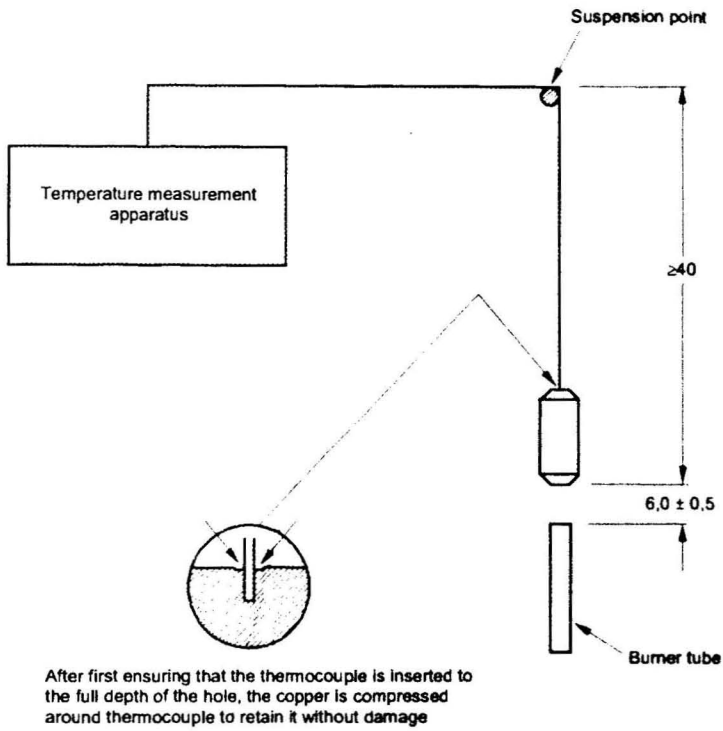


Copper block polished all over

Tolerance: $\pm 0,1$, ± 30 min (angular), unless otherwise stated
Material: high conductive electrolytic copper Cu-ETP UNS C 11000 (see ASTM-B187)
Weight: $0,58 \text{ g} \pm 0,01 \text{ g}$ before drilling

Figure A.1 – Copper block

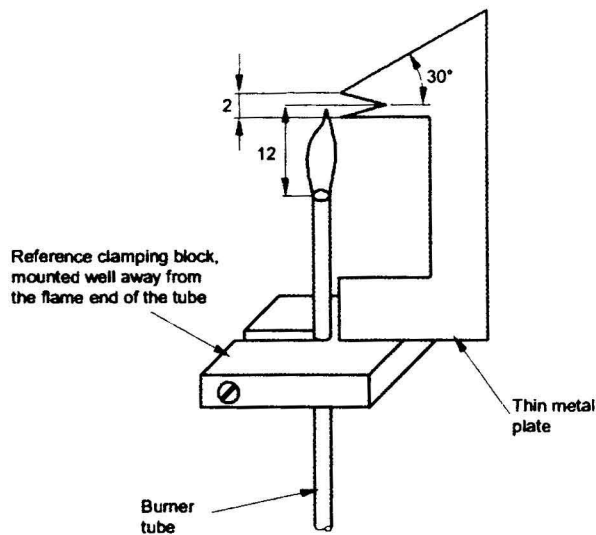
Dimensions in millimetres



The mode of suspension of the copper block shall be such that the block remains **essentially stationary** during the test.

Figure A.2 – Confirmatory test arrangement

Dimensions in millimetres



Tolerance: ± 1 , ± 5 (angular), unless otherwise stated

Figure A.3 – Gauge to measure flame height (example)

Annex B
(informative)

Access to equipment manufacturers and suppliers

An up-to-date list of equipment manufacturers and suppliers is maintained by the Secretary of IEC technical committee 89. The address details can be found on the IEC website: <http://www.iec.ch>

Bibliography

- [1] ISO 9626:1991, *Stainless steel needle tubing for the manufacture of medical devices*
 - [2] IEC 60695-11-40:2002, *Fire hazard testing – Part 11-40: Test flames – Confirmatory tests – Guidance*
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Review of Indian Standards

Amendments are issued to standards as the need arises on the basis of comments. Standards are also reviewed periodically; a standard along with amendments is reaffirmed when such review indicates that no changes are needed; if the review indicates that changes are needed, it is taken up for revision. Users of Indian Standards should ascertain that they are in possession of the latest amendments or edition by referring to the latest issue of 'BIS Catalogue' and 'Standards: Monthly Additions'.

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